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## U. S. DEPARTMENT OF AGRICULTURE.

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**FARMERS' BULLETIN 332.**

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**NUTS AND THEIR USES AS FOOD.**

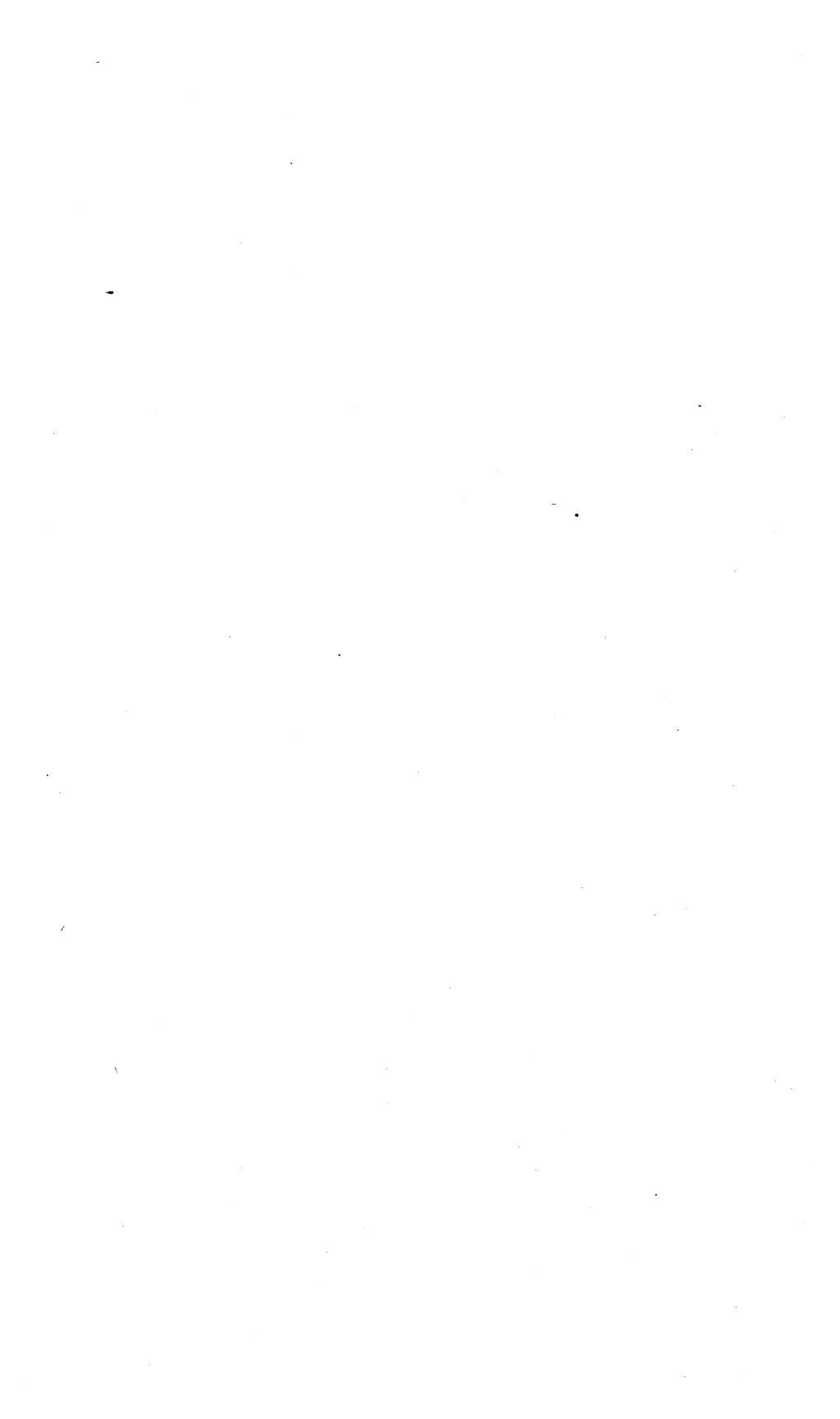
BY

**M. E. JAFFA, M. S.,***Professor of Nutrition, University of California.*

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PREPARED UNDER THE SUPERVISION OF THE OFFICE OF EXPERIMENT STATIONS,**A. C. TRUE, Director.**WASHINGTON:  
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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., June 3, 1908.*

SIR: I have the honor to transmit herewith and to recommend for publication as Farmers' Bulletin 332 an article on nuts and their uses as food, prepared by M. E. Jaffa, professor of nutrition of the University of California.

The present bulletin is a revision and extension of an article by Professor Jaffa bearing the same title which was published in the Yearbook of the Department for 1906, and constitutes a summary of available data on the flavor, composition, and digestibility of nuts and nut products, and on the general subject of nuts and their uses as food. For a number of years Professor Jaffa has studied the question of the food value of nuts and nut products as a part of the cooperative nutrition investigations of this Office and in this bulletin has drawn largely on the results of this work. The present bulletin is similar in purpose and scope to the popular publications which the Department has issued in the past summarizing available information on different food materials.

Respectfully,

A. C. TRUE,  
*Director.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



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## NUTS AND THEIR USES AS FOOD.

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### INTRODUCTION.

The constantly increasing consumption of nuts throughout the United States augurs well for a better appreciation of their food value. The time when nuts were considered merely as a luxury, or as something to be eaten out of hand at odd times, is rapidly passing away. In earlier days the native hickories, butternuts, walnuts, chestnuts, pecans, and many other nuts found in the United States were to be had in country regions for the gathering and were of no commercial importance. On the other hand, the English walnuts (to give them their most common name), almonds, cocoanuts, etc., brought from other countries, were relatively expensive luxuries.

Some nuts, like the native hazelnut and beechnut, still have practically no commercial value and, though palatable, are almost never offered for sale, doubtless because they are so small and difficult to gather in quantity. The chinquapin, a small nut allied to the chestnut, finds a limited sale in southern cities, but is doubtless seldom if ever seen in other markets. In general, however, conditions have changed and our principal native nuts are now staple market commodities and bring good prices. At the same time, owing to changes in market conditions, and to the growing of foreign nuts in quantity in this country, the price of the imported nuts has dropped so that they are well within the reach of the majority.

From available statistics it appears that in 1905 the total quantity of almonds, cocoanuts, Brazil nuts, filberts, peanuts, walnuts, and other nuts, shelled and unshelled, imported into the United States was, in round numbers, 86,238,000 pounds, with a value of \$6,138,000. In 1905 the total almond crop in California reached 4,200,000 pounds and the walnut crop 12,800,000 pounds. The richest yield of peanuts was reported from the Southern States, chiefly Virginia, Georgia, and Tennessee, and amounted to 225,000,000 pounds.

The total quantity of home-grown nuts, including both native and introduced varieties, must far exceed the quantities imported, but in the nature of the case no estimates of the total quantities gathered and eaten are procurable. When we consider the constantly increasing demand for nuts and the large quantity which we import from

other countries, the possibilities of the industry for the American nut grower are obvious. As the use of nuts has increased, many persons have turned their attention to the growing of native and foreign nuts on a commercial scale. This work has been forwarded by the Department of Agriculture, through the Bureau of Plant Industry, and by the California, Florida, Michigan, and other agricultural experiment stations. With nuts, as with other crops, it has been found that, by selection and breeding, improved varieties are obtainable, of larger size, better flavor, thinner shells, or other desirable characteristics.

The increased demand for nuts is due in the main to two causes, namely, a better appreciation of their appetizing qualities and the numerous ways in which they form a palatable addition to the diet of the average family, and, secondly, to their use by the vegetarians and persons of similar belief—a group small in proportion to the total population, but still fairly large numerically—who use nuts, and more particularly the peanut, as a substitute for meat and other nitrogenous and fatty foods.

Even a cursory examination of the journals devoted to cookery and other branches of home economics and of the various books which are published on the subject will show the fairly general use of nuts for making soups, for stuffing poultry, for nut butters, nut salads, cakes, salted nuts, and other dishes, and indeed several volumes devoted exclusively to nut cookery have been published.

Many special nut foods, such as malted nuts, meat substitutes, etc., have been devised and extensively advertised by the manufacturers for general use in the diet and for the special needs of vegetarians and fruitarians. It is said that some of these American nut products contain soy beans, but apparently the peanut plays a very important part in their composition. In either case, since the peanut, like the soy bean, is a legume, these preparations might more properly be compared with the bean cheese and other soy-bean products, so much used in China, Japan, and other eastern countries, than with such nuts as the walnut, almond, or cocoanut.

#### **DESCRIPTION OF NUTS.**

The term "nut" is not a definite one botanically speaking, but is applied indiscriminately to a variety of certain fruits or parts of fruits and implies a more or less hard, woody covering surrounding a meat or kernel. The most diverse plant groups contribute to our nut supply, many of the common nuts being the product of our beech, chestnut, walnut, and other deciduous trees and bushes. Not a few of the nuts which are eaten in large quantities are obtained from pines and tropical palms, while others, like the peanut and pistache

or pistachio, are obtained from leguminous plants, being the fruit, respectively, of a vine-like plant and a small tree. Still another, the water chestnut, is supplied by a water plant.

Most of the native and foreign nuts which we find in our markets are too familiar to need description. Several, however, are not so generally known.

Pine nuts, which grow in the cones of a number of varieties of native and foreign pines, are now fairly common in our markets. The Indians have always known and appreciated them and have passed on their knowledge to the white race. Then, too, many immigrants who came to this country knew the pine nut, for it has long been much eaten in Italy and other parts of southern Europe where there are a number of nut-yielding pines. A variety of pine nuts is used in India by natives and Europeans sometimes pounded and mixed with honey and sometimes like other nuts as dessert. In this country the small, rather pointed pine (*piñon*) nuts which are most common are usually marketed shelled, but as they grow are covered with a more or less hard, woody shell. The pistache nut (now grown in California) has long been used and is prized by confectioners for its delicate flavor and attractive green color, yet it is by no means common. The nuts are small, not unlike a bean in size and shape, though more pointed, and before marketing are freed from the pods in which they grow. The individual nuts are covered with a gray or purplish skin, and are blanched before they are used.

The so-called lichi nut, which is really a dried fruit surrounded by a nut-like shell and not unlike a raisin in flavor, is a favorite in China and has become quite common in this country since its introduction by the Chinese. The ginkgo nut, the fruit of an ornamental tree quite widely grown in the United States and sometimes called the maidenhair tree from the shape of the leaves, and which fruits abundantly in some regions, is seldom eaten except by the Chinese, who gather it whenever possible. The small, roundish, oval, thin-shelled nut is surrounded by a very acrid, bad-smelling pulp, the whole fruit being not unlike a green damson plum in size and appearance. In China, Korea, and other parts of the Orient this nut is much used as a food, but, so far as can be learned, is always cooked in some way. Roasted like a peanut, it has a pleasant flavor. The ginkgo nuts are on sale in the Chinese shops in San Francisco and doubtless in other cities, and were studied at the California experiment station some years ago, together with a number of other typical Chinese food materials.

The water chestnut, or horn chestnut (*Trapa bispinosa*), an aquatic plant, produces a seed or "nut" which somewhat resembles two curved horns united in one, the kernel of which is largely used as a

food by the inhabitants of Asiatic countries. This so-called nut is also on sale in the United States, but chiefly in Chinese shops. Another water plant (*Eleocharis tuberosa*) is also known as the water chestnut, but in this case it is the corm or bulb that is eaten. It is not unlike a chestnut in shape, and has a tough, brown skin. This is grown in Asia, but is imported by the Chinese in this country. A pointed nut or seed somewhat like a pecan in appearance, the pit of the Chinese olive (*Canarium* sp.), is also on sale at Chinese shops in the United States. The kernels are oily but palatable, resembling the common American butternut (*Juglans cinerea*) in flavor. Closely related species of *Canarium* nuts are also imported to some extent for general trade, though they are by no means common. The use of a "milk" or emulsion made from these nuts as an infant food is spoken of elsewhere (p. 20).

The candle nut of the Tropics is very oily, and after it has been stored for some time and is thoroughly dried is edible and by many considered palatable. If eaten too soon, however, the croton-oil-like body which it contains generally causes very serious illness. The chufa, nut grass, or earth almond is a small tuberous root of a sedge-like plant and may, perhaps, be classed more properly with the vegetables than with the nuts. It is not common, though eaten to some extent.

From time to time new nuts make their appearance on the market as some nut prized locally becomes known to the trade. A nut which seems to be growing in popularity, though still uncommon, is the Paradise nut of South America, which resembles a Brazil nut in appearance and flavor. Still less common is the South African cream nut, though it is sometimes shipped to this country. The choicest member of the Brazil-nut group is the true "butternut" of the Tropics, which is very seldom found outside that region. Its flavor is very delicate and delicious, but it does not keep well; and even if it would bear shipment successfully, the available supply is at present very small. The cashew nut of tropical regions, which many consider one of the most delicious nuts grown, has long been known, but has never become common. It is sold to some extent and brings high prices. Cashew-nut candy is also sold in a limited way in the United States. This nut must be roasted before it is eaten, as when raw it has poisoning properties which are, however, readily destroyed by heat.

The Kingsland chestnut was almost unknown a few years ago, but is now being cultivated in California. It somewhat resembles a filbert in appearance and is not a true chestnut. The tabebuia (*Telfairia pedata*), from Zanzibar, is a nut eaten roasted, which has been grown in a very limited way at the Porto Rico Agricultural Experiment Station, and is almost unknown, except in the region where it is native.

The so-called nuts are the seeds of a pumpkin-like fruit, and are oval, rather flat, and much larger than pumpkin seeds. The flavor is oily and fairly palatable. Should a demand arise it could be supplied by Porto Rican growers. The use of such a seed as a nut suggests the common use in Russia of the sunflower seed, which is rich in oil and not unlike some of the common nuts in composition. The raw sunflower seeds are eaten out of hand at all times and by all classes. In China watermelon seeds are eaten in the same way.

### THE FLAVOR OF NUTS.

The flavor of nuts is very largely dependent upon the oils which they contain, though in some there are also specific flavoring bodies. The nut oils readily become rancid, the very disagreeable flavor of spoiled nuts being due to this property. Some nuts (for instance, the chestnut) have a starchy flavor as well as a "nutty" taste. The small native nut is much more highly flavored than the large Italian or the Japanese chestnut. The almond possesses the cyanic-acid flavor, which is characteristic of peach pits, plum pits, etc., and this might be expected when it is remembered that the almond is the dried pit of an inedible fruit somewhat resembling the peach in appearance and closely related to it botanically. Most almonds are mild flavored. The so-called bitter almonds are, however, very strong, the cyanic acid yielding glucosid being present in considerable quantity. In raw peanuts there is a decided flavor resembling that of the closely related beans and peas, and to some persons this is not unpalatable. In the roasted peanut, which most of us prefer to the raw, the flavor is largely dependent upon the browned oils and starches or other carbohydrates.

### COMPOSITION OF NUTS.

The composition of nuts and nut products has been studied at a number of the agricultural experiment stations, notably California, Maine, and Iowa, and the following table summarizes the results of this work, the American data being supplemented in a number of cases by the results of European analyses. For purposes of comparison several other common food materials are also included.

*Average composition of nuts and nut products.*

Kind of food.	Refuse.	Edible portion.							
		Water.	Pro-tein.	Fat.	Carbohy-drates.		Ash.	Fuel value per pound.	
					Sugar, starch, etc.	Crude fiber.			
Nuts and nut products:									
Acorn, fresh.....	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories.	
17.80	34.7	4.4	4.7	50.4	4.2	1.6	1,265		
Almond.....	47.00	4.9	21.4	54.4	13.8	3.0	2.5	2,895	
Beechnut.....	36.90	6.6	21.8	49.9	18.0	3.7	2,740		
Brazil nut.....	49.35	4.7	17.4	65.0	5.7	3.9	3.3	3,120	
Butternut.....	86.40	4.5	27.9	61.2	3.4	3.0	3.370		
Candle nut.....		5.9	21.4	61.7	4.9	2.8	3.3	3,020	
Chestnut, fresh.....	15.70	43.4	6.4	6.0	41.3	1.5	1.4	1,140	
Chestnut, dry.....	23.40	6.1	10.7	7.8	70.1	2.9	2.4	1,840	
Horn chestnut or water chest-nut.....		10.6	10.9	.7	73.8	1.4	2.6	1,540	
Chufa (earth almond).....		2.2	3.5	31.6	50.2	10.5	2.0	2,435	
Cocoanut.....	34.66	13.0	6.6	56.2	13.7	8.9	1.6	2,805	
Filbert.....	52.08	5.4	16.5	64.0	11.7	2.4	3,100		
Ginkgo nut (seeds).....		47.3	5.9	.8	43.1	.9	2.0	940	
Hickory nut.....	62.20	3.7	15.4	67.4	11.4	2.1	3,345		
Lichi nut.....	41.60	16.4	2.9	.8	78.0	1.9	1,510		
Paradise nut.....	45.70	2.3	22.2	62.6	10.2	2.7	3,380		
Peanut.....	27.04	7.4	29.8	43.5	14.7	2.4	2.2	2,610	
Pecan.....	50.10	3.4	12.1	70.7	8.5	3.7	1.6	3,300	
Pine nut, Piñon.....	40.6	3.4	14.6	61.9	17.3	.....	2.8	3,205	
Pine nut, Spanish, or pignolia (shelled).....		6.2	33.9	48.2	6.5	1.4	3.8	2,710	
Pistachio.....		4.2	22.6	54.5	15.6	3.1	3,250		
Walnut.....	58.80	3.4	18.2	60.7	13.7	2.3	1.7	3,075	
Almond butter.....		2.2	21.7	61.5	11.6	3.0	3,340		
Almond paste.....	24.2	13.1	23.9	29.4	7.8	1.6	1,900		
Peanut butter.....		2.1	29.3	46.5	17.1	5.0	2,825		
Malted nuts.....	2.6	23.7	27.6	43.9	2.2	2,600			
Cocoanut candy.....	3.9	2.4	11.9	76.7	4.5	.6	2,000		
Peanut candy.....	3.0	10.3	16.6	66.9	2.1	1.1	2,115		
Chestnuts, preserved (marron glacé), air dried.....		18.2	1.3	.5	79.7	.3	1,530		
Walnuts preserved in syrup, air dried.....		16.9	13.6	20.0	48.6	.9	2,780		
Cocoanut milk.....	92.7	.4	1.5	4.6	.....	.8	155		
Cocoanut, desiccated.....	3.5	6.3	57.4	31.5	.....	1.3	3,125		
Peanut coffee made from entire kernel.....		5.1	27.9	50.1	12.3	2.4	2.2	2,805	
Almond meal.....		8.5	50.6	15.6	16.0	2.9	6.4	.....	
Commercial nut meal.....		3.0	29.0	51.7	12.1	2.0	2.2	.....	
Chestnut flour.....		7.8	4.6	3.4	80.8	3.4	1,780		
Cocoanut flour.....		14.4	20.6	2.1	45.9	10.1	6.9	1,480	
Hazelnut meal.....		2.7	11.7	65.6	17.8	2.2	3,185		
Almond diabetic biscuit a.....		5.3	29.0	8.8	54.3	.5	2.1	.....	
Commercial meat substitute b.....		55.2	12.7	21.8	6.3	1.8	2.2	.....	
Do. b.....		62.2	22.6	9.2	3.6	.9	1.5	.....	
Other foods for comparison:									
Meat, round steak.....		65.5	19.8	13.6	.....	1.1	.....	950	
Cheese, cheddar.....		27.4	27.7	36.8	4.1	4.0	.....	2,145	
Eggs, boiled.....	11.20	65.0	12.4	10.7	.....	.7	.....	680	
Wheat flour, high grade.....		12.0	11.4	1.0	74.8	.3	.5	1,650	
White bread.....		35.3	9.2	1.3	52.6	.5	1.1	1,215	
Beans, dried.....		12.6	22.5	1.8	55.2	4.4	3.5	1,605	
Potatoes.....	20.00	78.3	2.2	.1	18.0	.4	1.0	385	
Apples.....	25.00	84.6	.4	.5	13.0	1.2	.3	290	
Raisins.....	10.00	14.6	2.6	3.3	73.6	2.5	3.4	1,605	

<sup>a</sup> Contains some wheat gluten.<sup>b</sup> It is claimed that such goods are nut products.

Refuse, mostly shell, constitutes a considerable proportion of the nuts as purchased, varying greatly with the different kinds. With fresh chestnuts the proportion is nearly 16 per cent, dry chestnuts 23 per cent, peanuts 27 per cent, almonds 47 per cent, and butternuts 86 per cent.

The edible portion of nuts, with few exceptions, is very concentrated food, containing little water and much fat. In general, nuts are also rich in protein. Those ranking highest in this nutrient, the pignolia, a variety of pine nut imported from Spain, with 33.9 per cent, the peanut with 29.8 per cent, and the butternut with 27.9 per cent protein, surpass most ordinary animal or vegetable foods in this respect. The almond, beechnut, and pistachio, with 21.4 per cent, 21.8 per cent, and 22.6 per cent, respectively, compare favorably with dried legumes. The Brazil nut contains 17.4 per cent protein, the filbert 16.5 per cent, the walnut 18.2 per cent, the hickory nut 15.4 per cent, the pinenut 14.6 per cent, the pecan 12.1 per cent, and the dry chestnut but 10.7 per cent. The dry acorn, fresh chestnut, and cocoanut, with 6.4, 6.4, and 6.6 per cent, respectively, are not as rich in protein as bread.

Of the nuts here included the richest in fat is the pecan, with an average of 70.7 per cent, but 7 other varieties—the Brazil nut, butternut, candlenut, filbert, hickory nut, pinenut, and walnut—contain upward of 60 per cent. The almond, cocoanut, and pistachio yield between 50 and 60 per cent of this nutrient. The beechnut, peanut,

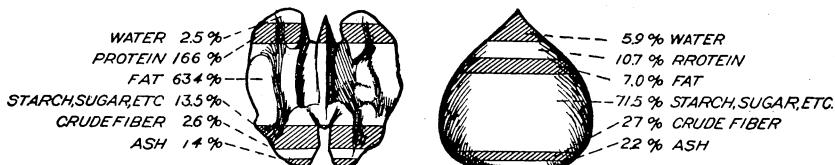


FIG. 1.—Percentage composition of an oily nut (walnut) and a starchy nut (chestnut).

and pignolia contain about 50 per cent. In other words, in 13 of the varieties of nuts appearing in the foregoing table, half or more of the edible portion is fat or oil.

Only a few of the commonly used nuts yield any notable amounts of total carbohydrate matter, the dry chestnut, with 73 per cent, rating highest. Beechnuts, pinenuts, and peanuts have about 18 per cent. The quantity of starch found is, with some exceptions, quite small, ranging from 3 per cent in the beechnut to 27 per cent in the chestnut.

Figure 1 shows in diagrammatic form the percentage composition of an oily nut, the walnut, and a starchy nut, the chestnut.

Nuts are, comparatively speaking, well supplied with mineral matter, this constituent in the majority of nuts exceeding 2 per cent. The ash of the walnut, almond, etc., is rich in phosphoric acid, and in this regard compares favorably with that of cereals. It would appear from the data on the digestibility of nuts that the mineral matter is as well assimilated as that from other common foods.

It is a matter of observation that the nuts of any given species produced in different regions, and indeed those from different trees of any

given region, vary decidedly in size, flavor, and composition, the hickory nuts, for instance, from one tree being much more oily than those from another in the same locality. Advantage is taken of such natural variations in selecting wild nuts for cultivation, notably in the case of pecans, where the range in size and quality is very noticeable.

#### DIGESTIBILITY OF NUTS.

With the exception, perhaps, of certain rich pies and puddings, no food material has the reputation for indigestibility that has been accorded to nuts. Discomfort from them is certainly not uncommon, and when it occurs it seems fair to say is largely due to insufficient mastication and to the fact that nuts are often eaten when not needed, as after a hearty meal or late at night; though it is undoubtedly true that nut protein as ordinarily eaten is not so easily or so completely digested as meat protein. Very likely the concentration of nuts, with but 3 to 5 per cent water, as compared with meats containing from 50 to 70 per cent water, is a contributing cause. If careful consideration were given to this matter and if attention were paid to the proper use of nuts and their correct place in the diet, there would be less unfavorable comment on their digestibility.

The results of investigations carried on with fruit and nut diets at the California Agricultural Experiment Station afford tentative conclusions regarding thoroughness of digestion which should be of value to those who wish to use nuts as a staple article of food rather than as an occasional article of diet. This work has comprised 15 dietary studies and about 100 digestion experiments with elderly men, young men, women, and children, of whom some had been vegetarians for years, and some had even limited their diet almost exclusively to fruit and nuts; others had previously lived on the usual mixed diet. The average coefficients of digestibility reported for 28 experiments with 2 men and 1 woman on a fruit and nut diet were: Protein, 90 per cent; fat, 85 per cent; sugar, starch, etc., 96 per cent; crude fiber, 54 per cent; and ash, 68 per cent, with 86 per cent of the energy available. The corresponding figures for three experiments with the same subjects in which no fruit or nuts were used are: Protein, 94 per cent; fat, 92 per cent; sugar, starch, etc., 96 per cent; crude fiber, 49 per cent, with 88 per cent of the energy available. The latter coefficients agree very closely with those in the average of nearly 500 experiments with different sorts of mixed diet, namely: Protein, 92 per cent; fat, 95 per cent; and carbohydrates, 97 per cent.

Nuts were the main source of protein for the fruitarians, and it will be noted that this constituent had practically the same coefficient of digestibility in the nut and fruit diet as in the other cases cited. The studies with fruitarians have all indicated that nut protein is fairly

well assimilated; and that this is true with the average healthy person is well illustrated by an experiment with a university student, who, though entirely unaccustomed to such fare, gradually changed from an ordinary mixed diet to one of fruit and nuts, which he followed for a time without apparent loss of health or strength.

It is somewhat difficult to arrive at definite conclusions regarding the actual percentage of nut protein digested or assimilated. The experimental data obtained at the California station show a range of 75 to 82 per cent digestible protein when fruit and nuts were eaten together, but the figure for nut protein is doubtless higher. These coefficients were in all probability influenced by the fruit protein, which has been found to be less digestible than the nut protein. The digestibility of protein in 28 experiments with mixed diets, to which were added fruit and nuts, averaged 90 per cent.

As fruits, with the exception of the avocado and olive, yield only a small amount of fat, the fat which is contained in a fruitarian diet must be very largely obtained from the nuts. The average coefficients of digestibility for this nutrient in 30 experiments with men on a diet of fruit and nuts was 86 per cent, and in 28 experiments just referred to it was 85 per cent. These figures are about 10 per cent lower than the average coefficient for digestibility of fats in the ordinary mixed diet. The digestibility of the carbohydrates in nuts, so far as the available data show, is about equal to that of the same ingredients in other foods.

So far as can be ascertained no experiments have been made on the ease or rapidity of digestion of nuts. In the absence of such data it is fair to assume that within reasonable limits the finer the state of subdivision of the food material the easier, the more rapid, and perhaps the more nearly complete will be the digestion or assimilation, presupposing, of course, that the nuts are not eaten in addition to a hearty meal. Too much stress can not be laid on the necessity of thorough mastication of nuts. This is emphasized by the results obtained with one of the subjects at the California station, a man at moderately active work, who ate largely of nuts but did not properly masticate his food. The coefficients of digestibility of the food were far lower than for other subjects who chewed their food thoroughly. The experiments with fruit and nut diets in general indicate that nut protein is as easily, even if not quite so completely, digested as protein from bread and milk.

The present discussion refers only to the nuts included in the studies at the California station, viz, the almond, Brazil nut, cocoanut, peanut, pecan, pignolia, and walnut. It is believed that these are typical of the ordinary edible nuts, but further digestion experiments are much needed for the purpose of testing some other nuts.

As regards the work of other investigators, both Memmo <sup>a</sup> and Merrill <sup>b</sup> report digestion experiments with cooked chestnuts. Memmo's subject was a farm laborer, 53 years old, working eight hours a day. The experiment lasted four days. During the first two the food consisted exclusively of chestnut products. This was modified during the last two days by the addition of herring and cheese. In this experiment 75 per cent of the protein, 87 per cent of the fat, 97 per cent of the total carbohydrates, and 83 per cent of the ash were assimilated. The last figure is exceptionally high; the others correspond to those reported for the California experiments with men on a fruit and nut diet.

The subjects of Merrill's experiments were two men aged 23 and 34 years, respectively. A mixed diet was used. Each subject consumed daily 300 grams of the cooked chestnut flour, which furnished about 20 per cent of the proteids, 50 per cent of the fat, nearly 50 per cent of the carbohydrates, and not far from 40 per cent of the total fuel value of the food. The average digestion coefficients obtained for chestnuts with the two subjects were protein 56 per cent, fat 63 per cent, and total carbohydrates 98 per cent, while 89 per cent of the energy was available. Memmo also studied a kind of acorn bread eaten in Italy, and found it was fairly well assimilated, though not very palatable. In experiments made by Saiki <sup>c</sup> at Yale University chestnuts were added to the diet to obtain data regarding the raw chestnut starch, and it was found that it was comparatively indigestible. This would suggest that it is desirable to cook chestnuts rather than to use them raw.

From the foregoing it would appear that, while it is not possible to determine the exact digestion coefficients for all nuts, enough has been done to indicate their high nutritive value and to show that the human system can assimilate a very large proportion of the nutriment contained in nuts when they are rationally eaten.

#### PLACE OF NUTS IN THE DIET.

It has been shown by numerous investigations that nuts are rich in protein and fat and that these nutrients can be fairly well assimilated. Nuts being such a concentrated food, their proper place in the diet is a matter for more careful consideration than is the case with many of the ordinary food materials. It must not be forgotten that a certain bulkiness of the diet is conducive to its normal assimilation, and that too concentrated nutriment is often the cause of digestive disturbances. It might be expected, then, that nuts could be most advantageously used in connection with more bulky foods, such as fruits,

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<sup>a</sup> Ann. Inst. Ig. Sper. Univ. Roma, n. s., 4 (1894), p. 263.

<sup>b</sup> Maine Sta. Bul. 131, p. 146.

<sup>c</sup> Jour. Biol. Chem., 2 (1906), p. 251.

vegetables, breads, crackers, etc. Most rationally used, they should constitute an integral part of the menu rather than supplement an already abundant meal. Since nuts are so concentrated, eating a considerable quantity out of hand at odd times will mean an over-supply of food if a corresponding reduction is not made in the quantity of other foods eaten during the day. The distress sometimes experienced when nuts are eaten is undoubtedly often due to improper mastication or to overindulgence, since investigations made at the California station indicate clearly that considerable quantities of nuts properly eaten do not cause distress. There is a popular belief that a little salt with nuts prevents the digestive disturbance resulting from eating them. To most persons salt undoubtedly adds to the palatability of the nuts, but no investigations have been found on record which demonstrate any actual improvement in the digestibility of nuts due to salt.

Considering all kinds, nuts are perhaps more often eaten raw than cooked, though some sorts like the peanut, which is not generally considered palatable raw, and the cashew nut, which is poisonous until roasted, are quite generally cooked.

In this country the native chestnut is very commonly eaten raw, and the small native nuts have a distinct and characteristic flavor. The European chestnut, when raw, is lacking in flavor and so is almost universally cooked. The Japanese chestnut is much like the European in its characteristics.

The cocoanut and the almond are important ingredients of many sorts of cakes and confectionery, and often nuts are used in cooking in many ways.

Nuts may be readily used as staple articles of diet, as an ingredient in salads and in soups, as a stuffing for poultry, in the making of desserts, and in many other ways. Wild turkey stuffed with pecan nuts is a dish popular with old Virginia cooks, just as goose stuffed with chestnuts is prized in Germany. Salted nuts and nuts crystallized in sugar are very common accompaniments of other foods. In general, the nuts rich in protein and fat should be used in combination with carbohydrate foods, as bread, fruit, green vegetables, etc., while such nuts as the chestnut, which do not contain much protein or fat, but are rich in carbohydrates, may be properly combined with meats, milk and cream, eggs, and other foods containing protein and fat.

Since nuts are relished by most persons, are nutritious, and may be readily used by themselves and in various palatable combinations as an integral part of the diet, they have a legitimate place in the menu. Those who, for any reason, wish to live on vegetable foods and dairy products or any form of vegetarian or fruitarian diet will almost inevitably look to nuts, particularly such as the peanut, for a considerable portion of their total nutritive material. A fruit and

nut diet may be arranged to furnish sufficient protein, mainly from nuts, to satisfy the requirements of the body, but the consensus of opinion of well-informed physiologists seems to be that such a diet is not generally advisable nor to be recommended for the majority of mankind in place of the more usual mixed diet. It should also be remembered that numerous experiments have shown that the protein from mixed diet has a higher coefficient of digestibility than nut protein, which indicates that the protein of nuts is the less economically utilized by the body. The argument which is so often advanced that primitive man lived on nuts and fruits exclusively and hence his descendants should do so is not generally accepted.

The comparatively high price of many of the edible nuts, particularly when shelled, and the difficulty of cracking some varieties—like pecans, black walnuts, and hickory nuts—and extracting the kernels at home, greatly militate against the freer use of nuts in the household. The consumption of peanuts and English walnuts is perhaps increasing faster than that of some other nuts; but, whatever sort is selected, they should, as already noted, form a part of the diet and not supplement an already sufficient meal.

#### **NUTS AND NUT PRODUCTS FOR DIABETICS.**

Nuts and nut products are often recommended as foods for diabetics and others from whose diet starch and sugar are excluded, or at least materially reduced. On this subject the following statements are made by A. L. Winton,<sup>a</sup> in a report of studies made at the Connecticut State experiment station of the composition of diabetic foods, chiefly commercial products:

Most of the nuts, including walnuts, Brazil nuts, almonds, and filberts, since they contain no starch and only small amounts of sugar and dextrin but are rich in protein and oil, are valuable additions to the diet of diabetics. Almond meal is used in the preparation of various biscuits and bread substitutes. The chestnut is a notable exception among nuts, in that it is rich in starch and poor in fat, the composition of the shelled nut being much the same as that of wheat flour; it is therefore entirely unsuited for the use of diabetics. \* \* \*

The peanut, \* \* \* although very rich in oil, contains about 11 per cent of starch, sugar, and dextrin, of which about half is starch.

#### **NUT BUTTERS AND NUT MILK.**

Within the last few years so-called nut butters have been used in increasingly large amounts, and at least one variety, namely, peanut butter, is made and sold in ton lots. It has already been stated that in order to insure the best physiological results from the dietetic use of nuts they should be thoroughly ground up by the teeth and that, other things being equal, the digestion coefficient will vary directly

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<sup>a</sup> Connecticut State Sta. Rpt. 1906, p. 153.

with the fineness of division. The nut butters, made as they are from the finely ground nuts with or without the addition of some water, oil, and salt, have a homogeneous consistency not unlike true butter, and when properly made the material is so finely divided that even if it is not thoroughly chewed it will presumably offer much less resistance to the digestive juices than nuts hastily eaten. Nuts, and hence nut butters, are very rich in fat, which readily becomes rancid and unpalatable. This is doubtless one of the reasons why nut butters are quite commonly marketed in jars, etc., containing small amounts which may be utilized in a short time. The nut butters are recommended by vegetarians as a substitute for butter in culinary processes and for use at the table. By persons who are not vegetarians they are commonly used for making sandwiches and in other ways for their agreeable flavor and for the pleasing variety which they give the diet.

Nut butter may be easily made at home. The nuts may be pounded in a mortar, but a mill for grinding them is much more convenient and may be readily procured, as there are a number of sorts on the market. The process of making nut butters has been frequently described in journals and cookery books. Either the raw or the roasted peanut may be used for making peanut butter, but the roasted nut is the more satisfactory. The kernels should be freed from chaff and reduced to a paste in the grinding mill. Freshly roasted nuts are necessary, as those which have stood for a day or so after roasting lose in crispness, do not grind well, and tend to clog the mill. Any sort of nut may be used, but experience has shown that it is more difficult to make butters from the almond or Brazil nut than from the peanut. Blanching these nuts requires considerably more time and labor than is needed to free the peanut from the skin which covers the kernel, and they are also more difficult to grind. Nut butters will keep well if sealed in glass or earthenware jars. Tin cans also may be used, but are not quite as desirable. As might be expected, nut butters do not differ materially in composition from the nuts from which they are ground. (See table, p. 12.)

The nut butters just mentioned are entirely different from cocoanut butter or from cocoa butter, which are expressed and purified fats. Cocoanut butter, which is sold under a variety of trade names, is made, it is said, by extracting and refining the fat from the sliced and dried cocoanut or copra. Its natural color is white, and it is solid at ordinary temperatures, resembling refined beef fat in appearance. It is used as a substitute for butter and in various culinary ways. Chocolate and cocoa, as is well known, are both products of the cocoa bean, the former being much richer in fat than the latter. The

fat which is extracted in the manufacture of cocoa is called cocoa butter and is used as a culinary fat and for other purposes. It is an entirely different product from the cocoanut butter mentioned above.

The liquid in the cocoanut, often called cocoanut milk, is not at all the same as the nut milks often referred to in books devoted to nut cookery, which may be made by mixing nut butter of any given sort with water.

By pouring a pint of boiling water on a freshly grated cocoanut, allowing it to stand until cold and then straining it, a milky liquid is obtained which is also sometimes called cocoanut milk or cream and is used in cooking and other ways in regions where cocoanuts are grown. On standing, the fatty portion rises to the top as cream rises on milk. Cocoanut cream may be served with fruits and used in other ways. These cocoanut products and similar articles made from other nuts are used to some extent by the strict vegetarians who do not care to use cows' milk.

A similar nut milk or emulsion of nut fat made from Java almonds (a species of Canarium) is used in Java, apparently with considerable success, as an infant food.

#### **NUT PASTES AND NUT PRESERVES.**

Pastes which are used by confectioners for candy making and in other ways are made from nuts with the addition of sugar. Sometimes water and starch are added, but such admixtures are inferior to the nut and sugar pastes. The most common material of this sort is the almond paste, which is manufactured in large quantities in the United States and is also imported. It is used for making cakes, candies, etc., the highly ornamented cakes called "marzipan," so popular with the Germans, being one of the very well-known almond-paste confections.

Macaroons are also well-known cakes made from ground almonds or almond paste. Cocoanut is also used for the same sort of cakes.

Chestnuts preserved or candied in sirup and then dried, the marrons glacé of the confectioners, are esteemed a delicacy and are eaten alone or are used in confectionery, etc. Thus prepared they are a common commercial article. Much less common are the English walnut meats preserved in sirup, which are manufactured in Europe and exported to this country in limited quantities. Preserved nuts which are similar to these are made in this country, particularly for the soda-water trade. Often maple sirup is used instead of ordinary sirup. Nut sirups, in which the ground nuts are incorporated with the sirup, are also well known for the same purpose, and are quite similar to the nut bisques or similar pudding sauces made at home.

As the data in the table on page 12 show, such nut preserves are rich in carbohydrates, owing to the added sugar. In Germany walnut meats and spice are often added to the plum butter which is made in such quantities in many homes. In the Tropics a thick, sweet preserve is made from cocoanut and sugar which is much liked locally, though those who are not familiar with it consider it very sweet and insipid. The Turks make several products from walnut meats and grape juice which are considered wholesome and palatable foods. In one of these the nuts are strung on a strong thread and dipped in thickened grape juice until well coated with it.

#### NUT FLOURS AND MEALS.

Among nut products may be mentioned nut flours and meals. Some of these are used in large quantities and are made on a commercial scale, while others, perhaps owing to the trouble and expense incidental to manufacture, find only a limited use. In general, meals are made from the ordinary edible nuts by blanching, thoroughly drying, and grinding. By using a nut mill such meals may be ground at home. Analyses of some products of this character will be found in the table on page 12. Almond meal has been on the market for a long time, being used as food for diabetics (see p. 18) and for making cakes, etc., as well as in a number of technical ways.

Special mention should be made of chestnut flour, which is on sale in the United States and is used for most of the culinary purposes for which the fresh nut is recommended. In Italy it constitutes a considerable part of the diet, in some regions being extensively used for making a sort of bread or cake. One of the most complete studies of the dietetic use of chestnuts has been reported by Memmo.<sup>a</sup> According to the author, the chestnut often serves almost as the exclusive food of the peasants of Tuscany for a considerable part of the year. The whole nuts are eaten in a variety of ways; for instance, boiled in water without hulling, hulled and boiled, or roasted. From the flour various cakes and other foods are made. Sometimes dough made from chestnut flour and water is spread between chestnut leaves and baked in an oven, and sometimes the dough is baked between hot stones. Chestnut fritters are also used, though less commonly than the bread, as the oil needed to fry them is comparatively expensive. A half pound or more of chestnut flour made into porridge for breakfast, chestnut cakes for dinner, and chestnut porridge or macaroni for supper, with a little fish or cheese, is a common day's ration. Ground acorns, made into a sort of bread with the addition of about 75 per cent of flour, is a common article of diet in several regions, notably Umbria and Tuscany, but the bread is black and heavy and not very palatable.

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<sup>a</sup> Loc. cit. (see p. 16).

The early travelers and explorers make mention of the extended use of nuts by the American Indians, and the custom of using acorns as a staple food is still kept up. The methods of preparing acorns followed by the Indians of northern California have been described by P. E. Goddard <sup>a</sup> in a publication of the University of California, and by V. K. Chesnut, <sup>b</sup> formerly of the Department of Agriculture. Briefly speaking, the shelled nuts are split, dried, and ground with a mortar and pestle. The sifted flour is placed in a hollow in the sand on a convenient river bank and leached to free it from the bitter principles present. From the leached meal a porridge or mush is made, which to the ordinary palate is much improved by the addition of salt.

These typical Indian foods, when well prepared, are relished by many persons who have tried them, and it seems not improbable that improved methods of removing the tannin and bitter principles present in most varieties of acorns might result in the utilization of the acorn crop, which is fairly large throughout most regions of the United States and is generally wasted.

According to Chesnut's <sup>c</sup> investigations, the California buckeye or horse-chestnut is also used by the Indians as a food and is leached to free it from poisonous or objectionable matters in much the same way as the acorn. Many attempts have been made in Europe and elsewhere to treat the fruit of the common horse-chestnut in some way so that it might be made wholesome and palatable, for it undoubtedly contains an abundance of nutritive material, particularly starch; but none of these attempts has been really successful.

In many regions nuts are commonly added to ordinary bread dough, and such nut bread is a favorite and staple food. The use of partly extracted peanuts and other nut meals with wheat and rye flour for bread making should also be mentioned. Such breads have been used for patients with diabetes, but have never come into general use, perhaps because they are not very palatable, since the nuts become rancid so readily. In this connection the coarsely ground or shredded and dried cocoanut so common in our markets should be mentioned. Sugar is often added during the process of manufacture. Such prepared cocoanut is commonly used when it is not convenient to use the fresh nut. The cocoanut is much used in fancy cooking in the United States. In regions where it is grown it is a staple food. The pulp of the immature nut is considered a delicacy, and is used in many ways. When frozen and served as an ice it is said to be especially delicious. The meat of the ripe nut is used in the preparation of a great variety of dishes, including sweets as well as other foods, and the cocoanut milk, particularly that of the unripe

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<sup>a</sup> Univ. Cal. Pubs., Amer. Arch. and Ethnol., 1 (1903), No. 1, p. 27.

<sup>b</sup> U. S. Dept. Agr., Div. Bot., Contrib. Nat. Herbarium, 7 (1902), p. 333.

<sup>c</sup> Loc. cit., p. 366.

nut, is a very common and wholesome beverage. The so-called "milk" is in reality water which the plant stores in the nut and is very pure, containing only a little mineral matter, sugar, etc., in solution. In addition to the fact that it is palatable and usually cool, it is a much safer beverage than water from some possibly contaminated spring or stream.

### **NUT CANDIES.**

One of the most extensive uses of nuts is in the manufacture of candy of various sorts, such as sugared almonds, burnt almonds, nut chocolates, caramels, pinoche, nut brittle, etc. While there are some differences in the process of manufacture followed in these candies, they all in the main consist of nuts and sugar in varying proportions, with flavoring extracts, and in some instances butter and flour. Perhaps the best known nut candy the world over is nougat, which is of oriental origin, and is a compound originally made of nuts and honey, but now more often of nuts and sugar. Usually almonds, filberts, pistachios, and pinenuts are employed in nougat making, but the kind of nut is necessarily very largely a matter of convenience. Sometimes burnt almonds are used instead of the blanched nuts. The nougat which our confectioners supply is soft in texture, but a brittle, hard sort is made in Europe and is imported to this country from Spain, the oblong blocks, about 6 by 4 by 2 inches, being wrapped in wafer and sealed in tins.

The table on page 12 shows the composition of common sorts of nut candy. As may be seen, the water content is low and these candies are highly concentrated foods. On account of the added sugar the carbohydrate content is high. The proportion of nuts used in candies varies. By assuming that the nuts furnish the bulk of the fat in the candy, it is estimated that nuts constituted about 50 per cent in the specimens analyzed. It is perhaps well to suggest that nut candies and other candies which sometimes cause digestive disturbances would be more satisfactory if eaten in a rational way and at the proper time. Since they are concentrated foods, they should naturally replace an equivalent amount of some other food material and not be eaten in quantity simply for their palatable flavor in addition to an otherwise adequate daily ration.

### **NUT COFFEES.**

A number of coffee substitutes made from nuts have been devised and placed on the market, peanut coffee and acorn coffee being by far the most common. The nuts are parched and sometimes otherwise treated. Such coffee substitutes lack the stimulating properties of true coffee, and the infusion does not have the high nutritive value which is sometimes claimed for it.

### GREEN NUTS.

A number of kinds of nuts are used before they are fully ripe, and are esteemed a delicacy. In California in spring the markets quite commonly offer green almonds—that is, the almonds picked from the tree while the husk is of a decided green color and easily separated from the soft and immature shell. The kernel, after the skin is peeled off, is eaten with or without salt, and is relished by many persons. The price of green almonds in California markets commonly varies from about 20 to 35 cents per pound. Green almonds are found to a limited extent in fancy fruit shops in Eastern cities and elsewhere, and are perhaps purchased as much for their ornamental appearance as for their palatability. They are much more commonly used in Europe than in the United States. Green English walnuts and green hazelnuts are also eaten to a considerable extent in Europe and are great favorites. The nuts are gathered when the shells are fully matured but not thoroughly ripe. Sometimes these green nuts are imported into the United States. Many who have grown up in the country will recall the delicate flavor of the immature butternut and hickory nut and the stained fingers which they caused. Such green nuts have apparently never been marketed.

Whole green walnuts and some other nuts are also used in a quite immature state for pickle making. They are picked when still tender enough to be easily pierced by a large pin; then, after being kept in brine for a number of days, they are exposed to the sun until they turn black. Afterwards they are placed in jars and covered with hot vinegar and spices. Sometimes they are treated with dry salt instead of brine before pickling. It is claimed that nuts thus treated will blacken without being exposed to sunlight. Such pickled nuts are considered by many as a very palatable relish for use with meats and poultry. Walnut catsup is also made from green walnuts.

### NUT OILS AND OIL-CAKE MEALS.

In some parts of Europe almond oil, walnut oil, and beechnut oil are manufactured and prized as salad oils, and in South America Brazil-nut oil is used for table purposes. Cocoanut oil is an important oil in the Tropics. Peanut oil finds a large technical application and is also used in large quantities as a salad oil and for culinary purposes. Oils are also made from the kernel or nut of the peach and apricot, but these, like most nut oils except those mentioned, are used for medicinal or technical purposes rather than for food.

The various nut oils, which are practically pure fats, have a very high fuel value, and like olive oil and other oils, may constitute an important energy-yielding constituent of the diet. It is commonly assumed that, like olive oil, these oils are readily assimilated when

properly combined with other food materials, as in salads, as "shortening" for various dishes, and in similar ways.

The oil-cake meals, as the ground products remaining after the expression of the nut oils are called, are much used as food for live stock and all kinds of poultry, and this is especially true of the peanut and cocoanut oil cakes. It has been suggested that such oil-cake meals might be valuable dietary articles if properly manipulated, as they of course contain a higher percentage of protein than the original nut. Some attempts have been made to thus utilize peanut-cake meal, but the results have not been very satisfactory.

### PECUNIARY ECONOMY OF NUTS.

The composition and digestibility of nuts have been discussed in the foregoing pages, but little has been said regarding the cost of nutrients and energy which they supply as compared with other and more common food materials. The table which follows shows the comparative cost of a pound of protein and 1,000 calories of energy when furnished by different nuts and nut products and some other staple foods, and also the amounts of nutrients and energy which 10 cents' worth of these foods would supply, rating the foods at certain average prices per pound.

*Pecuniary economy of nuts and nut products.*

Kind of food.	Price per pound.	Cost of one pound protein.	Cost of 1,000 calories energy.	Total weight of food material.	Amount for 10 cents.			
					Pounds.	Pounds.	Pounds.	Calories.
<b>Nuts and nut products:</b>								
Almonds.....	20	1.76	13.0	.50	.06	0.14	0.14	767
Brazil nuts.....	20	2.28	12.6	.50	.04	.16	.02	789
Chestnuts.....	8	1.48	8.3	1.25	.07	.06	.44	1,196
Cocoanuts.....	5	1.16	2.7	2.00	.08	.73	.29	3,662
Hickory nuts.....	9	1.55	7.1	1.11	.06	.28	.04	1,404
Peanuts.....	7	.32	3.6	1.43	.31	.45	.20	2,767
Pecans.....	15	2.47	9.1	.67	.04	.23	.04	1,003
Pignollas.....	25	.74	8.4	.40	.14	.20	.03	1,182
Pistachios.....	20	.88	6.1	.50	.11	.27	.08	1,124
Walnuts.....	20	2.66	16.0	.50	.04	.13	.03	633
Almond paste.....	40	3.17	21.0	.25	.03	.06	.10	475
Peanut butter.....	20	.68	7.1	.56	.15	.23	.09	1,412
Peanut candy.....	25	2.42	11.8	.40	.04	.07	.28	845
<b>Other foods for comparison:</b>								
Porterhouse steak.....	25	1.31	22.5	.40	.07	.07	-----	444
Whole milk.....	4	1.21	12.0	2.50	.08	.10	.13	815
Cheddar cheese.....	16	.58	7.5	.62	.17	.23	.03	1,330
Wheat flour.....	3	.26	1.8	3.33	.38	.03	2.50	5,495
Beans, dried.....	5	.22	3.1	2.00	.45	.03	1.19	3,210
Potatoes.....	2	1.11	6.4	5.00	.09	-----	.74	1,550

The common nuts—though, with the exception of the peanut, they are more expensive sources of protein and energy than meat and a number of the common foods—may yet be considered reasonably cheap sources of nutrients and energy, and hence may be regarded as justifiable additions to the diet on the score of economy. For

the vegetarian or fruitarian, who looks to nuts as the chief source of protein in the diet, the peanut must be considered as much the most economical. As may be seen by a reference to the table, 10 cents will purchase more protein and energy when expended for the flours and meals than for any of the other foods, but it must be remembered in this connection that these are the raw materials requiring considerable preparation before they are palatable. This is not necessary with fruits and nuts, except in the case of the peanut and chestnut, which are usually roasted before they are considered palatable by most persons, though there are those who prefer them raw. When considering nuts, it is readily observed that 10 cents will buy about the same amount of nut protein as of animal protein, except in case of cheese and skim milk. If spent for peanuts, it will purchase more than twice the protein and six times the energy that could be bought for the same expenditure for porterhouse steak.

It is of more than passing interest to note that 10 cents' worth of peanuts will contain about 4 ounces (120 grams) of protein and 2,767 calories of energy, which is more protein and energy than is furnished by many rations regarded as adequate for a day. Although peanuts supply protein and energy for a smaller sum than bread, they are outranked by dried beans, which, at 5 cents a pound, will supply for 10 cents over 200 grams of protein and 3,200 calories of energy. If more peanuts and dried beans were used by fruitarians, their diet would be enriched and the cost decreased. The almond, so much in favor with fruitarians, furnishes for 10 cents about one-fourth the protein and less than one-third the energy supplied by peanuts.

#### **HANDLING AND MARKETING NUTS.**

Within the last few years the trade in shelled nuts has very markedly increased, and shelled walnuts, hickory nuts, almonds, English walnuts, pecans, etc., are now very commonly found in shops. The bulk of the nut crop is, however, marketed unshelled. Some of the unshelled nuts, notably pecans and peanuts, are very often polished before marketing by rotating them in rapidly revolving drums in such a way that the shells are worn down until they are more or less smooth. This method of treatment also removes any dirt and is supposed to make the nut more salable. It is worthy of note, however, that the highly prized, large fancy pecans are marketed without such treatment.

In cracking nuts, if one wishes to obtain the meats unbroken, it is necessary, as everyone knows, to hold the nut in such a position that the shell will be crushed along certain definite lines. Thus, hickory nuts must be struck on the thin side and pecan nuts and native butternuts or white walnuts on the end. With such nuts as the

almond and filbert or cobnut less care is needed, as the nut is loose inside the shell. There are a number of machines for cracking nuts on a wholesale scale for market purposes, which give a very large proportion of unbroken nut meats. In most of these the nuts passing from a hopper to some device like an endless chain with pockets for holding them in the right position are crushed one at a time by automatically moving plungers. The machines which are used naturally vary in principle and in details of construction, one which would be satisfactory for a peanut or soft-shelled almond being less well adapted for use with such nuts as hickory nuts or pecans. Some of the machines used for peanuts and almonds are equipped with devices for removing the skin or hull which covers the nut meat.

In order to meet the market demand for clean and uniformly colored nuts, many nut growers have resorted to the process of bleaching their product. The first attempts in this direction were made by sulphuring—that is, by exposing the nuts to sulphur vapor. This treatment, though improving the color of the shell, proved injurious to the flavor of the nuts and lessened the keeping qualities. At the California Agricultural Experiment Station experiments with bleaching solutions have been carried on and very satisfactory results have been obtained with a mixture of sal soda, chlorid of lime, and water. According to reports of the imperial department of agriculture of the West Indies,<sup>a</sup> a similar process has been successfully used for bleaching peanuts. The consumer should bear in mind that the bleaching of nuts is entirely unnecessary and in no way increases their food value. The process is carried on solely for the purpose of improving the appearance of the nut, and thus commanding a higher price. It will doubtless be continued as long as the public is willing to be guided by appearance rather than food value. The term "bleaching," as applied to nuts, must not be confounded with the household term "blanching," which applies to the process of removing the skins from nut meats, as almonds and pistachio nuts, by immersing them for a short time in hot water and then rubbing off the skin.

Vegetables and fruits exposed for sale under ordinary conditions may be readily contaminated with bacteria, dirt, and dust. Nuts sold in their shells are protected in large measure from such contamination, yet many careful housewives wash, or at least wipe, the nuts which are to be cracked and served in the shells, as anything which adheres to the shell might readily contaminate the nuts after cracking, if all were mixed together in a dish.

Shelled nuts are now common commercial products. They are sometimes sold in tight packages, but more often are not thus protected from dust and insects, and should always be washed before

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<sup>a</sup> Imp. Dept. Agr. West Indies Pamphlet No. 43, n. s.

they are used. Pouring hot water over nuts which are to be used for salad and other dishes is a practice which is recommended, as it removes any acrid taste and gives the nuts a fresh flavor and appearance.

If exposed to damp conditions, nuts mold and decay, and even under favorable conditions the nut oils and fats become rancid on long-continued storing. In the main, however, the keeping qualities of most nuts are excellent. Nuts, and particularly shelled nuts, should be stored in such a way that they may be free from attacks of insect enemies. When such precautions are not taken, "wormy" nuts are by no means uncommon.

#### **SUMMARY.**

Summarizing the foregoing data, it may be said that nuts are a very concentrated food, even more so than cheese, but when rationally used they are well assimilated and may form a part of a well-balanced diet. Nuts are a very valuable source of protein and fat, these two nutrients being the characteristic constituents of the more common nuts, of which the walnut and cocoanut may be taken as types. In nuts like the chestnut, carbohydrates are a characteristic constituent. For most families it is undoubtedly wiser to use nuts as part of the regular diet than as a condiment or supplement to an otherwise hearty meal.

Vegetarians and others who use nuts in place of meat should not depend upon them as the main food supply, but should supplement them with more bulky foods with a low content of protein and fat. As a whole, nuts may be classed among the staple foods and not simply as food accessories. At usual prices, nuts are reasonable sources of protein and energy. Peanuts supply protein and energy very cheaply, even compared with such staple foods as bread and beans. There are a number of nut foods on the market, but it may be stated that there is little to be gained from the standpoint of food value or economy in their use in place of the ordinary nuts and home-made nut products, especially by healthy persons who are willing to masticate their food thoroughly and to use nuts in reasonable combinations. Unless something has been added, the nutritive materials in such special preparations can not be greater than the nuts from which they are made, though in the mechanical condition or in some other way the foods may be better fitted for ready assimilation. Furthermore, nut butters and similar foods give a pleasant variety to the diet, and they are relished by many who would not care for the unprepared nuts.

Though less subject to contamination than many other foods, nuts should be handled and stored under good conditions, and especially should be protected from dampness and insect enemies.